Body Mass Index as an Assessment Tool for Overweight and Obesity in School Children in El-Qalubia Governorate

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Abstract: Aim of the study was to design BMI (Body Mass Index) charts to the studied group, to determine the prevalence of overweight and obesity in the group and to provide suitable recommendations for prevention overweight and obesity. Methods: This was a cross sectional study that included 500 students collected from primary and preparatory schools, aged 7-15 years and living in El-Qalubia governorate through the academic year 2010/2011. A self administered questionnaire was used; it included some socio-demographic characteristics and measurements for weight and height of students. Data was collected, revised and entered using the statistical package SPSS. Results: Obese students represented 20.4% of students. Obesity increased in younger students with mean age 9.33±2.094 years and increased in male students (55% of all obese students), while overweight increased in female students (54.5% of all overweight students). Female students recorded higher values over males in weight during the first 5 years of age (7-11 years old) then, boys become heavier than girls. Moreover, there was a gradual increase in height of female and male students at age 7-15 years old. In addition, the current study indicated that female students have the higher values of BMI from age 7 to 15 years old than males.
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Keywords: BMI (kg/m^2), obesity, and overweight.

1. Introduction

The increasing prevalence of overweight and obesity in childhood poses an ever-increasing problem. Since childhood, overweight affects both the children's health and their social integration and these children tend to become obese adults **(Reinehr et al., 2010).**

The recent rapid increase in childhood overweight and obesity are highly attributed to the modern obesogenic environment. Insufficient physical activity, changes in dietary habits and sociodemographic and environmental factors have been widely associated with higher weight in children and adults **(Marja et al., 2009).**

In a report from the Egyptian National Nutrition Institute, there is increasing prevalence of obesity among children and adolescents reaching 5.8% among males and 9.7% among females **(Abul Magd, 2009).**

Programmes of obesity prevention in schoolchildren should promote healthy eating patterns, especially a decrease in caloric intake, and enhanced physical activity, including reduced sedentary behaviour and adequate opportunities to pursue a more active lifestyle **(Zellner et al., 2007).**

Subjective assessment of childhood overweight and obesity has been shown in both clinical practice and publication to be inadequate, and therefore we need to perform objective assessment. Weight itself is an inadequate measure, given its relation to height, but body mass index (BMI) has been shown in childhood not only to screen for excess fatness, but also to be related to morbidity and it meets the following criteria: the simplicity of the measure, the cost, ease of use, and acceptability to the subjects **(SING,2003).**

The body mass index (BMI) is calculated from a person's weight in kilograms and height in meters (kg/m2). Childhood overweight and obesity are identified by using the international cut-off points, based on average centiles estimated to pass through BMI values **(Cole et al., 2000).**

BMI is an excellent choice of instrument for the definition of childhood overweight and obesity, as it changes with age and differs between sexes, so age and sex- specific centile charts are needed for childhood, with use of cut-off levels. There is widespread support for the use of BMI in childhood **(SING, 2003).**

Although obesity is caused by both genetic and environmental factors, the changes in environmental factors are likely to cause a more change in BMI percentiles. However, the change of the BMI distribution raises the question of whether some individuals are genetically more susceptible to changes in these environmental factors than others are **(Kurokawa et al., 2009).**

Overweight and obese children are at increases risk of a range of medical conditions affecting cardiovascular health (hypertension, hypercholesterolemia), the endocrine system (insulin resistance, impaired glucose tolerance hyperinsulinism, menstrual irregularity, type 2 diabetes mellitus), the pulmonary system (asthma, obstructive sleep apnea syndrome), the musculoskeletal system (genu varum, slipped capital femoral epiphysis), and mental health (depression, low self-esteem, distorted body image, eating disorders) **(Lobstein et al.,2004).**

2. Subjects and Methods:

The present work was a cross-sectional study.

Sample

Random sampling of students aged 7-15 years with a total number of 500 students of both sexes was included in the study (primary and preparatory schools), living in El-Qalubia governorate through the academic year 2010/2011. The students of the study were collected from schools in urban and rural areas.

Data collection

The data were collected by using a semi structured, self-administrated questionnaire guided by researcher's instructions. The questionnaire included socio-demographic characteristics and measurements for weight and height of students. Students were weighed to the nearest one kg, lightly dressed and barefooted. Standing height was measured to the nearest one cm, with shoes off, feet together and head in the Frankfort horizontal plane **(Tokmakidis et al., 2007).** Body mass index (BMI) was calculated as: Body weight (Kg)/ [height(m)]^2. Overweight and obesity were identified using age and gender specific international cut-off points, based on average centiles estimated to pass through BMI values **(Cole et al., 2000).**

Table (1): The international cut off points for definition of overweight and obesity (Cole et al., 2000).

BMI cut-off values / Age (years)	Overweight		Obese	
	Males	**Females**	**Males**	**Females**
7	17.92	17.75	20.63	20.51
8	18.44	18.35	21.60	21.57
9	19.10	19.07	22.77	22.81
10	19.84	19.86	24.00	24.11
11	20.55	20.74	25.10	25.42
12	21.22	21.68	26.02	26.67
13	21.91	22.58	26.84	27.76
14	22.62	23.34	27.63	28.57
15	23.29	23.94	28.30	29.11

The socio-demographic data for all students was considered regarding; the age, sex, residence, monthly income of family **(Modified from Fahmi and El-Sherbini, 1983).**

Data were collected, revised and analyzed.

Statistical analysis

Data were collected, revised and entered using the statistical package SPSS. The collected data was tabulated and analyzed with the suitable statistical methods using mean value ± standard deviation, T-test, analysis of variant and chi square test. BMI was calculated for each age and sex separately. The mean values and standard deviation were determined for each age and sex, and graphically smoothed. P value of less than 0.05 was considered statistically significant.

3. Results

Normal weight students were 42.2% while overweight students were 37.4% and the obese students were 20.4%. As regard age, this study revealed that obesity increased in younger students with mean age 9.33±2.094 years. More over obesity increased in male students (55% of all obese students), while overweight increased in female students (54.5% of all overweight students).

Regarding weight, female students recorded higher values over males in weight girls during the first 5 years of age (7-11 years old) then, boys become heavier than girls. Moreover, there was gradual increase of height of female and male students at age 7-15 years old. In addition, the current study indicated that female students have the higher values of BMI from age 7 to 15 years than males (Table 1).

Table 2 illustrated that the prevalence of the students of normal weight was 42.2% while that of overweight was 37.4% and that of the obese students was 20.4%. And figure (1) revealed such distribution.

Table 3 illustrated that obesity increased in younger students with mean age 9.33±2.094 years with a highly significant relation between groups.
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Table (2): Prevalence of normal weight, overweight and obesity in the studied group.

The groups	No.	%
Normal weight	211	42.2
Over weight	187	37.4
Obese	102	20.4
Total	500	100.0

Figure (1): Prevalence of normal weight, overweight and obesity in the studied group.
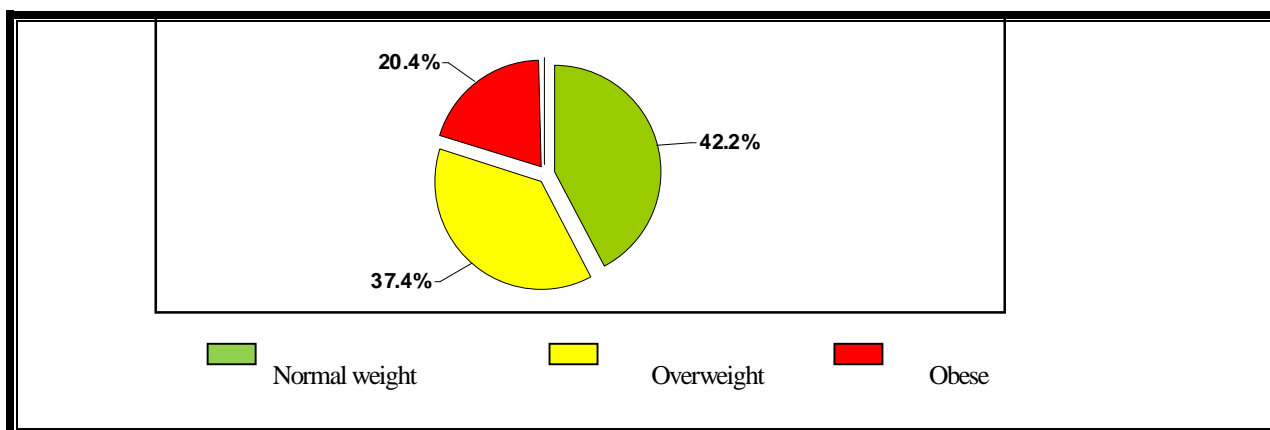
Table (3): The mean values of age for the groups

Age (year)	The groups			f	p	Between groups
	Normal weight (n=211)	Overweight (n=187)	Obese (n=102)			
Range	7-15	7-15	7-15	37.4	<0.001	P1<0.05
Mean	11.16	11.83	9.33			P2<0.05
±S.D	2.584	2.225	2.094			P3<0.05

P1 = normal and overweight   P2 = normal and obesity   P3 = overweight and obesity

Table (4): Distribution of the studied group according to sex

Sex	The groups						Total	
	Normal weight		Overweight		Obese			
	No.	%	No.	%	No.	%	No.	%
Male	108	43.40	85	34.10	56	22.50	249	100.0
Female	103	41.00	102	40.70	46	18.30	251	100.0
Total	211	42.20	187	37.40	102	20.40	500	100.0

X^2=2.6   P>0.05

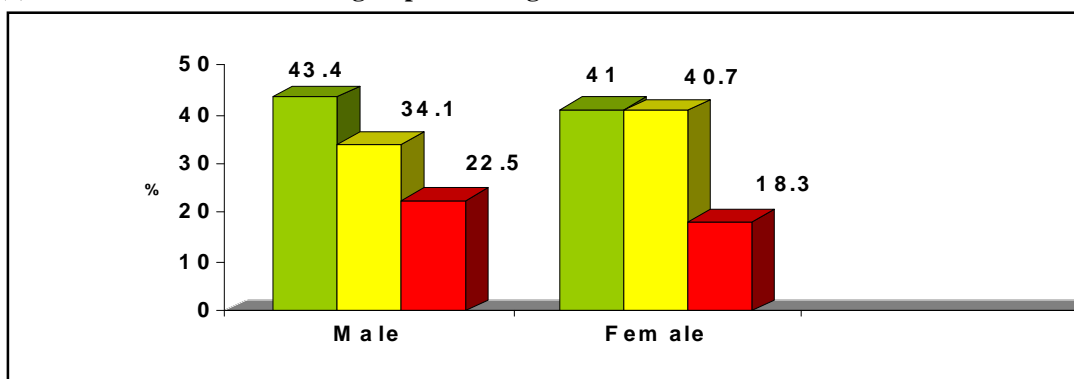**Figure (2): Distribution of the studied group according to sex**

Table 4 illustrated that obesity increased in male students (55% of all obese students), while overweight increased in female students (54.5% of all overweight students). And that was statistically insignificant. And figure (2) revealed such distribution

Table (5): Distribution of the studied group according to residence

Residence	The groups						Total	
	Normal weight		Overweight		Obese			
	No.	%	No.	%	No.	%	No.	%
Urban	99	40.6	58	23.8	87	35.6	244	100.0
Rural	112	43.7	129	50.4	15	5.9	256	100.0
Total	211	42.20	187	37.40	102	20.40	500	100.0

$X^2 = 78.4$ $P < 0.001$

Table 5 illustrated that obesity increased in urban students (85% of all obese students) while overweight increased in rural students (69% of all overweight students) with a highly significance.
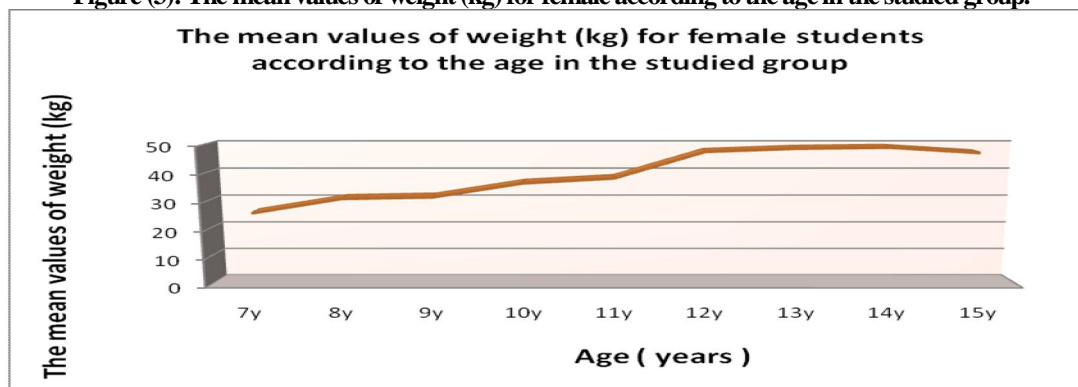
Table (6): The mean values of weight (kg) for female and male students according to the age in the studied group.

Weight (kg) / Ages	Female		Male	
	Mean	Standard deviation	Mean	Standard deviation
7 years	25.68	5.61	24.13	5.01
8 years	30.85	7.74	28.35	6.49
9 years	31.40	9.57	34.25	10.61
10 years	36.39	10.10	32.72	8.63
11 years	38.14	7.78	36.75	7.74
12 years	47.55	12.40	45.30	9.43
13 years	48.67	8.35	50.02	7.83
14 years	49.03	7.15	45.86	7.80
15 years	47.10	11.30	51.85	11.80

This table illustrated that female students recorded higher values over males in weight during the first 5 years of age (7-11 years old) then, boys become heavier than girls. And figure (3 & 4) revealed that.

Figure (3): The mean values of weight (kg) for female according to the age in the studied group.
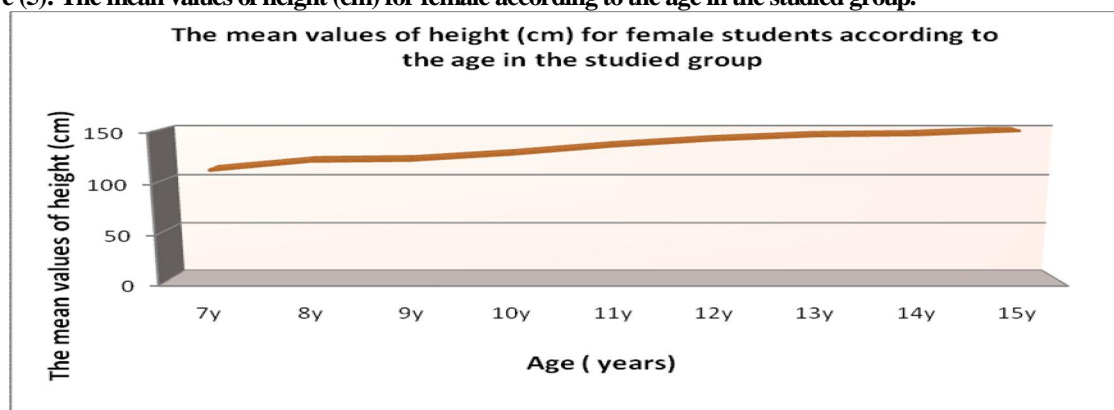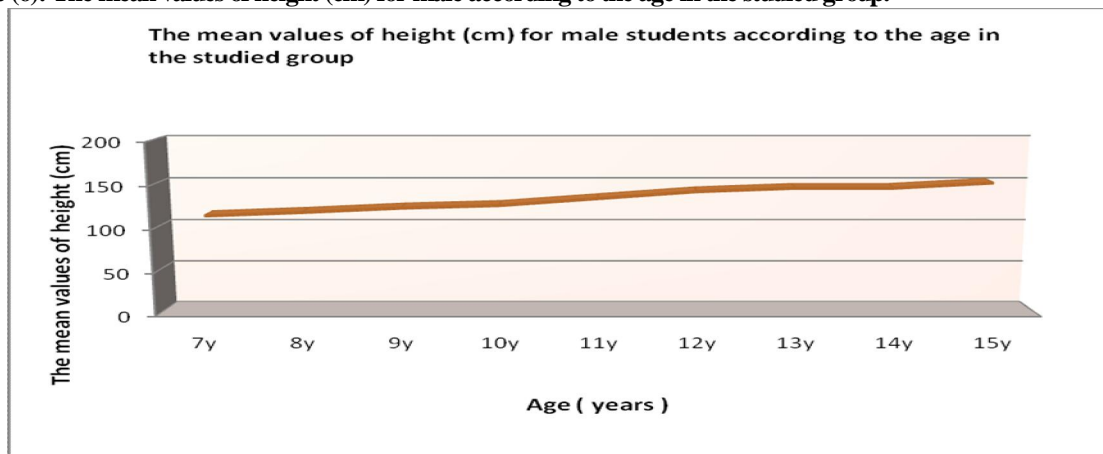
Figure (4): The mean values of weight (kg) for male according to the age in the studied group.

The mean values of weight (kg) for male students according to the age in the studied group.
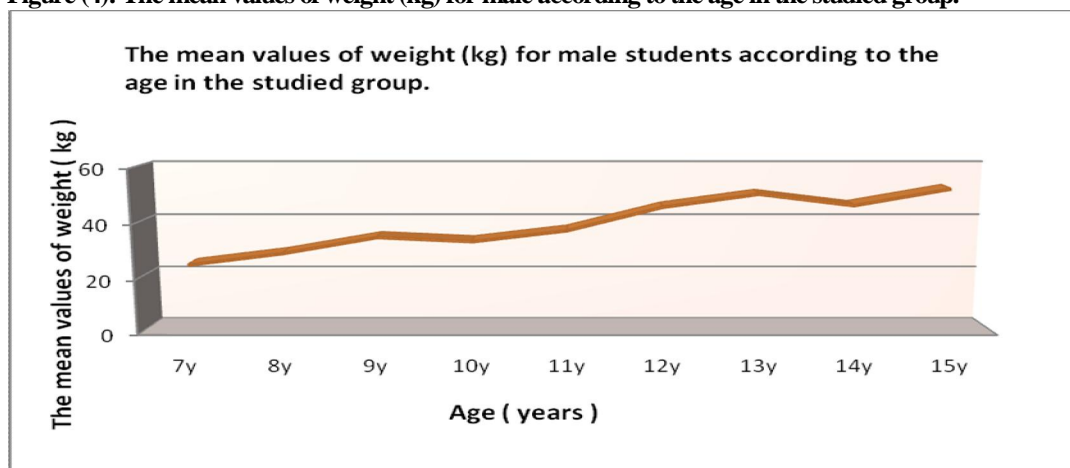
Table (7): The mean values of height (cm) for female and male students according to the age in the studied group.

Height (cm) Ages	Female		Male	
	Mean	**Standard deviation**	**Mean**	**Standard deviation**
7 years	111	7.9	113	5.7
8 years	120	6.1	117	7.4
9 years	121	8.9	122	7.6
10 years	127	8.3	125	8.8
11 years	135	7.5	133	9.6
12 years	141	7.1	141	7.5
13 years	145	6.4	145	6.7
14 years	146	5.3	145	7.4
15 years	150	7.5	151	7.8

This table illustrated that there was a gradual increase of height of female and male students at age 7-15 years old. And figure (5 & 6) revealed that.

Figure (5): The mean values of height (cm) for female according to the age in the studied group.

The mean values of height (cm) for female students according to the age in the studied group

Figure (6): The mean values of height (cm) for male according to the age in the studied group.

The mean values of height (cm) for male students according to the age in the studied group

Table (8): The mean values of BMI (kg/m^2) for female and students according to the age in the studied group.

BMI / Ages	Female		Male	
	Mean	Standard deviation	Mean	Standard deviation
7 years	21.2	5.4	18.9	3.7
8 years	21.4	5.2	20.9	5.1
9 years	21.3	4.6	22.7	5.5
10 years	22.9	8.3	21.0	4.6
11 years	20.9	3.1	20.7	3.5
12 years	23.5	4.7	23.0	4.8
13 years	23.1	3.0	23.9	3.2
14 years	22.9	2.7	21.7	3.4
15 years	20.9	3.4	22.8	5.3

This table illustrated that female students have the higher values of BMI from age 7 to 15 years than males. And figure (7 & 8) revealed that.
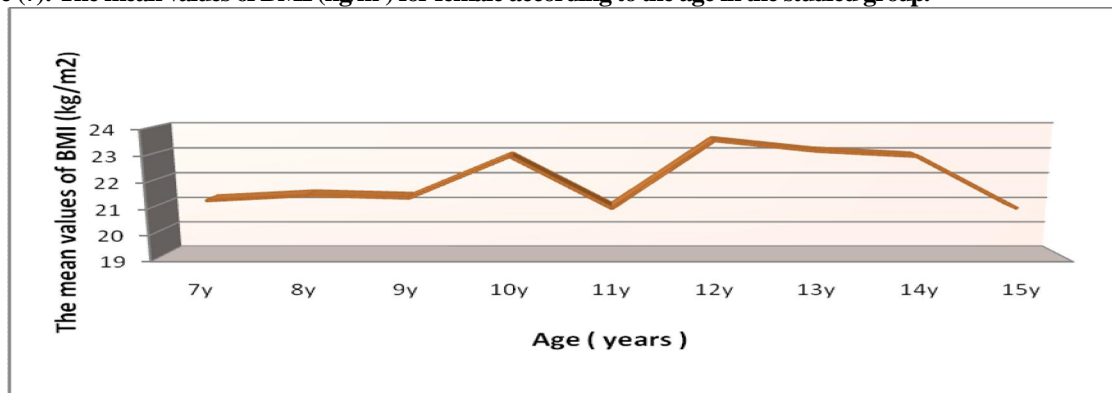
Figure (7): The mean values of BMI (kg/m^2) for female according to the age in the studied group.

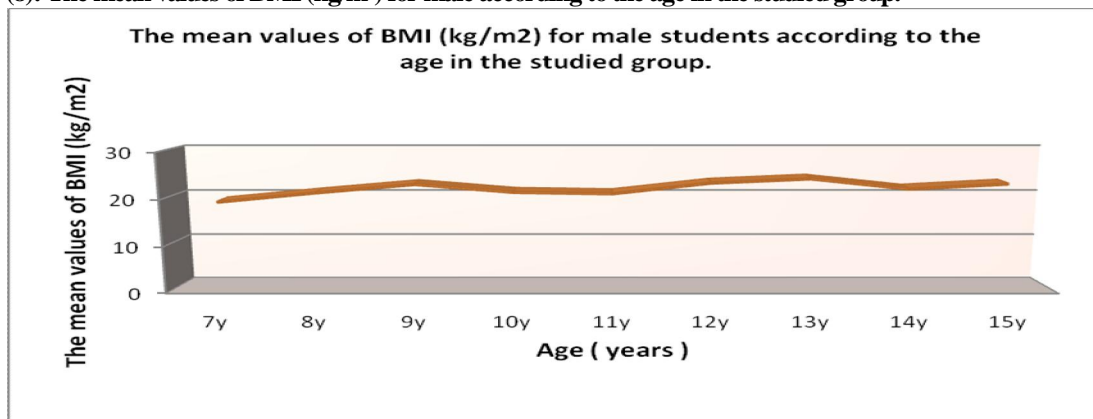**Figure (8): The mean values of BMI (kg/m^2) for male according to the age in the studied group.**

The mean values of BMI (kg/m2) for male students according to the age in the studied group.

Table (9): The mean values of the monthly income of the family (L.E.) for the groups .

Monthly income of the family (L.E.)	The groups			f	p	Between groups
	Normal weight (n=211)	Overweight (n=187)	Obese (n=102)			
Range	250-2100	100-2000	400-2500	6.3	<0.05	P1>0.05
Mean	863.46	809.36	954.80			P2<0.05
±S.D	326.121	298.477	396.464			P3<0.05

P1 = normal and overweight   P2 = normal and obesity   P3 = overweight and obesity

This table illustrated that the mean values of monthly income for the normal subjects was 863.46±326.12 LE, for the overweight subjects it was 809.36±298.47 LE and for the obese subjects it was 954.8±396.46 LE. This was statistically significant.

Table (10): Correlation between monthly income (L.E.) and BMI (kg/m^2)

	Monthly income	
	r	p
BMI (kg/m^2)	0.1	>0.05

This table illustrated that there was a positive correlation between monthly income (L.E.) of the family and BMI (kg/m^2) of the students which was statistically insignificant and figure (9) revealed these results.
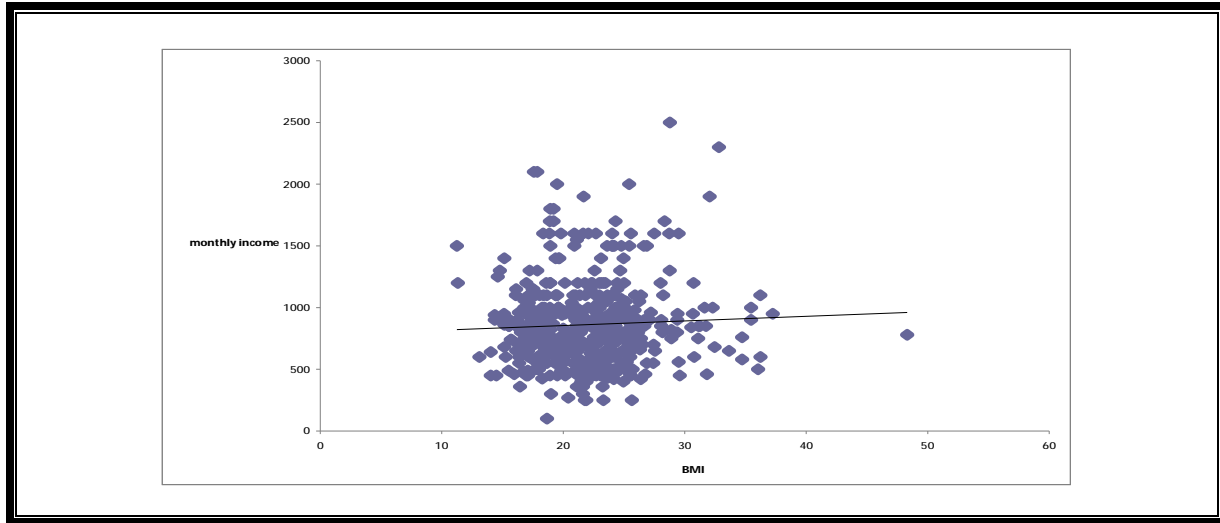
Table (11): Distribution of the studied group according to social class.

Social class	The groups						Total	
	normal weight		overweight		obese			
	No.	%	No.	%	No.	%	No.	%
High social class	147	42.9	127	37.0	69	20.1	343	100.0
middle social class	59	43.1	49	35.7	29	21.2	137	100.0
Low social class	5	25.0	11	55.0	4	20.0	20	100.0
Total	211	42.2	187	37.4	102	20.4	500	100.0

**X^2=3.3**   **P>0.05**

Figure (9): Correlation between monthly income (L.E.) and BMI (kg/m^2)

This table illustrated that the percentage for distribution of the studied group in subjects of high social class was 42.9% of the normal weight, 37.0% of the overweight and 20.1% of the obese. The percentage for distribution of the studied group in subjects of middle social class was 43.1% of the normal weight, 35.7% of the overweight and 21.2% of the obese. The percentage for distribution of the studied group in subjects of low social class was 25.0% of the normal weight, 55.0% of the overweight and 20.0% of the obese. More than two thirds of obese students belonged to high social class families. This was statistically insignificant and figure (10) revealed such distribution.

Figure (10): The distribution of the studied group according to social class.
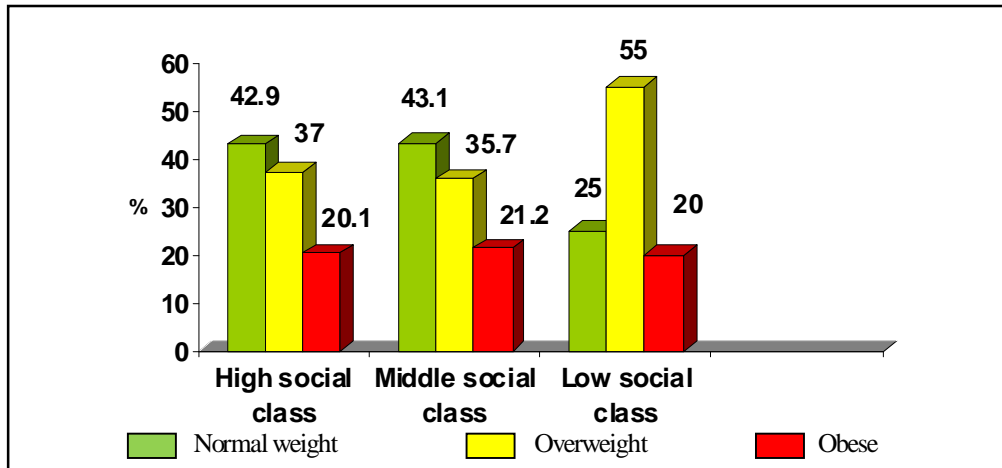
Findings from the present study indicated that obesity increased in urban students (85% of all obese students) while overweight increased in rural students (69% of all overweight students).

The current work revealed that the mean monthly income for the normal subjects was 863.46±326.12 LE, for the overweight subjects it was 809.36±298.47 LE and for the obese subjects it was 954.8±396.46 LE. More than two thirds of obese students belonged to high social class families.

4. Discussion:

Obesity in children has increased dramatically in recent years. In many developed countries childhood overweight and obesity has reached epidemic proportions, as these has been doubled in the past 20 years **(Hedley et al., 2004)**. Among children aged 5 to 17 years, about 155 million are estimated to be overweight; 30 to 45 million of them are classified as obese **(Lobstein et al., 2004).**

This study was conducted to reveal the prevalence of overweight and obese children among the

studied group at the governmental schools at El-QALUBIA, using the body mass index and the international cut off points for definition of overweight, and obesity **(Cole et al,. 2000).**

It was a cross sectional short-term study that was conducted on female and male students of the governmental schools at El-QALUBIA during the academic year 2010/2011. The data were collected from participants and their parents with the help of simple self-administered questions as well as weight and height measurement.

This study comprised 500 students. Their parents were consented for the study after explaining its purpose and method and after exclusion of those who refuse or were absent from the school.

The overall prevalence of overweight subjects was 37.4%. Moreover, it was for the obese subjects 20.4%. These results were different from that among Menoufiya and Assuit female students which were (44.4% and 14%) for overweight and (13.4% and 7.8%) for obese respectively **(Farahat and Abou El-Fath, 2001).** Possibly, this was because the difference in sex of the students in both studies.

As when the age of the children increases, the interest of their bodies' forms increases; it was found in the current study that the mean age of the normal weight subjects was 11.16±2.584 years and 11.83±2.225 years for the overweight subjects while it was 9.33±2.094 years for the obese subjects. These findings were confirmed by **Chrzanowska et al., (2007)** who found that the greatest increase in BMI was in the youngest age groups (7–12 years for boys and 7–10 years for girls).

Salem et al., (2002) found that the prevalence of obesity among Egyptian children was 14.7% and 15.08% for males and females respectively, their age ranged from 12-18 years. These finding did not agree with results in the current work which revealed that prevalence of obesity among the studied group was 22.5% for males and 18.3% for females. The difference in age group between the students in both studies might be the cause of the different results.

As regard weight of female students, the current study revealed that there was acute increase of weight at age 7-10 years old followed by gradual increase at age of 10- 14 years then decreased at the age of 15.

As regard weight of male students the current study revealed that there was gradual increase of weight at age 7-15 years old. Female students recorded higher values over males in weight except at the ages of 13 and 15 years boys were heavier than girls. This was not in agreement with **Yamamah et al., (2010)** who found that boys recorded higher values in weight over girls during the first 8years of age, after that, girls have higher values than boys at ages 9 to 14. This

difference might be due to the small sample size of the current work.

As regard height of female and male students the current study revealed that there was gradual increase of height at age 7-15 years old.

Regarding BMI, female students have the higher values of BMI than males except at the ages of 9, 13 and 15 years boys have the higher values than girls. These results were confirmed by **Yamamah et al., (2010)** who found the same results in their study 5245 healthy children in South Sinai aged 9-16 years old.

As regard BMI of female students the current study revealed that there was gradual increase of BMI at age 7-10 years old followed by slightly decrease at age of 11 years then re-increased at the age of 12 and 13years finally it decreased again at the age of 14 and 15 years. These changes might be due to growth spurt in this age but at the age of 14 and 15 the interest of body shape of girls affected their weight so they decreased their weight for beauty.

As regard BMI for male students the current study revealed that there was rapid increase of BMI at age 7-9 years old followed by rapid decrease at age of 10 and 11 years then more rapid re-increased at the age of 12 and 13years finally it gradually decreased again at the age of 14 and 15 years. These changes might be due to growth spurt in this age but at the age of 14 and 15, the height of males increase more than weight leading to decrease BMI and that was revealed from the current study as height affected BMI more than weight.

In developing countries, the transition from rural agrarian to urban economies has accelerated the appearance of the obesity, which is accompanied by shift in overall health burden from infectious disease and under nutrition to western chronic diseases such as cardiovascular disease, cancer and diabetes **(Oken and Gillman, 2003).**

That appeared in the current work as it was found that about one third of urban students were obese while only few percent (5.9%) of rural students were obese. This is in agreement with **Martinez (2006)** and who found that obesity was less prevalent in rural adolescents as rural life style and dietary habits there, may be contributing factors to adjust weight among rural adolescents.

As revealed from the current work, the comparison regarding to the residence for the overweight subjects it was found that about one fifth of urban students were overweight while one half of rural students were overweight. **Jackson et al., (2003)** did not report the same results as he said" In a study among female adolescents in Egypt overweight was more prevalent in urban girls than in rural girls".

As some socio-economic factors influence quality and quantity of consumed food, through

varied income, food habits and life style **(Khalil, 1999),** the current work revealed that the mean monthly income for the normal subjects was 863.46±326.12 LE , for the overweight subjects it was 809.36±298.47 LE and for the obese subjects it was 954.8±396.46 LE. This is not in agreement with **Canoy and Buchan (2007)** and **Moreira and Padra (2006)** who found that obesity depends on the stage of economic development as it increases in low-income countries and decreases in high-income countries. This could be attributed to that the difference in social characters of the studied groups. As when monthly income in the western countries increases, health-orientation and nutritional regimen following increase, leading to decrease the weight. On the contrary in eastern countries, high monthly income increase food consumption leading to increase the weight.

While **Fernald (2007)** found that the highest social group had significantly higher BMI when compared with other groups, the current study did not report any significant relation between social class and obesity. This could be attributed to that in the current study students who belonged to low social class were only 4.0% while those belonged to high social class were 68.6%.

Recommendations:
I- Parents:
Educate parents about:
1- Hazards of obesity in childhood.
2- Importance of making healthy foods easily available to the child and serve these foods in positive mealtime situations in order to help their child develop healthy food habits.
3- Developing the sense of trust and attachment to provide adequate physical, emotional and nutritional care for obese especially those complaining of complications.
4- Encouraging children to participate in physical activities to follow diet control especially for fat, refined sugar and sport drink and weight control.
5- Integrating physical activity into daily life, not just to increase leisure time exercise.

II - Schools:
1- Integrating adequate information about healthy life and importance of monitoring weight regularly within school curriculum.
2- As overweight and obese students are at risk of being school underachievers, hence, the construction of special classes in regular schools or special schools for those with profound handicapping. School playgrounds should be constructed, bearing in mind the needs of obese. School curriculum must provide adequate information about healthy life and importance of monitoring weight regularly.
3- Adequate sessions for physical exercises should be stressed up on in school for proper physical and psychological fitness.

4- Educate students not to practice bad behavior and try to avoid or correct sedentary life style.
5- Proper understanding the concept of school insurance that has been emerged to ease the financial burden of medical care and to optimize the use of available health services.
6- Weight monitoring and weight control should be periodically checked for school students even without periodical examination.
7- School nurse has the duty of supervision of required drugs especially for that drugs which must be provided daily in co-ordination with home.

III- Role of NGOs (Non Governmental Organizations):
Increase in the number of constructed youth clubs and to provide these clubs with all facilities for the welfare of all students, bearing in mind the needs of overweight and obese students.

IV-Government:
1-The Ministry of Health should stress on the presence of Nutrition labels on fast-food packing.
2- The Ministry of Health should provide continuous medical education for general practitioners, nurses and specialist to upgrade their knowledge about:
- The magnitude of the problem.
- Risk factors and complications.
-Ways of prevention and prope management.
-Health care of all students and better case finding to prevent the occurrence of related complications.
3- The supreme council for youth and sports has the duty of proper physical and mental states for students in general and overweight and obese in particular.

Conclusion:
It could be concluded from this study that obesity among both primary and preparatory school children is a prevalent problem in the studied group in El-Qalubia governorate, with a tendency to badly affect the children, so, it is suggested that research efforts should focus more on this area with emphasize on intervention for prevention. This study recommended another researches should be done on larger sample size and more different places in El-Qalubia governorate and the other governorates to compare the results with each other.

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